

June 1, 2001

MEMORANDUM TO: Chairman Meserve

FROM: William D. Travers */RA/*
Executive Director for Operations

SUBJECT: DIFFERING PROFESSIONAL OPINION ON STEAM GENERATOR
TUBE INTEGRITY ISSUES

As requested by your memorandum dated May 4, 2001, the staff has reviewed Dr. Hopenfeld's memorandum to the Commission dated April 24, 2001, concerning the relationship between a license amendment recently approved for South Texas Project Unit 2 (STP-2) and the issues that Dr. Hopenfeld raised in his Differing Professional Opinion (DPO) related to steam generator (SG) tube integrity. Specifically, you requested that the staff review Dr. Hopenfeld's memorandum and determine if there is any new information provided that would warrant additional examination or reconsideration of the staff's actions in granting the STP-2 license amendment on March 8, 2001, or in granting other amendments allowing licensees to leave tubes in service that exceeded the 2-volt limit at the beginning of the last cycle.

The amendment dated March 8, 2001 (ADAMS Accession No. ML010710090), approved the application of a 3-volt alternate repair criteria (ARC) limit for use during the current operating Cycle 9 for STP-2. The amendment only applies to hot-leg side SG tubes experiencing outer diameter stress corrosion cracking (ODSCC) at the tube-to-tube support plate intersection. As discussed in Generic Letter (GL) 95-05, voltage-based repair limits allow a flawed SG tube to remain in service if the eddy current bobbin coil test voltage is below the ARC voltage limit. The GL 95-05 voltage limit is 1 volt for plants with 0.75-inch-diameter tubes, and 2 volts for plants with 0.875-inch-diameter tubes. Since STP-2 has 0.75-inch-diameter tubes, the 1-volt limit would normally apply, not 2 volts, as conveyed in Dr. Hopenfeld's memorandum. There are presently no amendments other than the STP-2 amendment dated March 8, 2001, that allow licensees to exceed the GL 95-05 voltage repair limits during their current operating cycle.

Dr. Hopenfeld's memorandum did not raise any new issues. However, the results of the STP-2 tube inspection by the licensee during the 8th refueling outage (in March 2001, subsequent to issuance of the amendment), revealed new information concerning SG tube leakage at tube-to-tube support plate locations that relates to issues discussed in the DPO.

The results of the STP-2 SG tube inspection for the 8th refueling outage were provided to the Nuclear Regulatory Commission (NRC) in the licensee's Technical Specification-required "Special Report on Steam Generator Tube Inspection Results" dated March 28, 2001 (ADAMS Accession No. ML010940005). In addition, the preliminary results of the SG tube inspection

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were discussed in a series of conference calls between the NRC staff and the licensee on March 19, 26, and 27, 2001, as documented in a letter from the NRC to the licensee dated April 5, 2001 (ADAMS Accession No. ML010950107). The licensee reported that STP-2 experienced operational primary-to-secondary leakage for the first time during Cycle 8. The total leak rate for all four SGs at the end of Cycle 8 was 35 gallons per day (gpd) with the leak rates for SGs 2A, 2B, 2C, and 2D being 10.5, 7.5, 8, and 9 gpd, respectively. During the 8th refueling outage, a secondary side tube leak test was performed according to Electric Power Research Institute (EPRI) guidelines to identify possible leaking tubes. The testing identified approximately 100 tubes that were leaking. Based on eddy current inspection of the SG tubes, the licensee attributed the operational leakage to several large voltage eddy current indications characterized as ODSCC located at the tube-to-tube support plate intersection.

The new information revealed as a result of the STP-2 SG tube inspection was that this was the first domestic plant that has experienced measurable operational leakage at tube-to-tube support plate intersections associated with ODSCC confined to within the thickness of the tube support plates. The licensee's Special Report on the SG tube inspection results stated that STP-2 is the only domestic plant to use stainless steel drilled hole support plates. The Special Report also stated that two Belgian plants also have stainless steel drilled-hole support plates and that one of these plants experienced operational leakage that was attributed to ODSCC at tube-to-tube support plate intersections during outages in 1990 and 1992. The staff that was involved with the STP-2 3-volt ARC amendment review was unaware of the information related to the Belgian plants at the time the review was being performed. For plants with carbon steel tube support plates, leakage from tube cracks is restricted due to support plate corrosion. On the basis of the expectation that tubes with ODSCC indications located at the tube-to-tube support plate intersections would not leak significantly at that location, the staff had previously concluded that a realistic risk assessment of the 3-volt ARC would not result in a significant risk increase.

Subsequent to the secondary side tube leak testing and eddy current testing described above, the STP-2 licensee performed in-situ pressure testing of several of the tubes that had eddy current indications at the tube-to-tube support plate intersection. The in-situ testing demonstrated that a flaw, located at tube to stainless steel (vs carbon steel) tube support plate intersection, that leaks at roughly 1 gpd during normal operation could open under the increased pressure difference of a design basis accident to leak at roughly 1 gallon per minute (gpm).

The staff's review of the 3-volt ARC amendment request for STP-2 was performed using both deterministic and probabilistic assessments of SG tube structural integrity. The licensee did not submit a risk-informed application and the staff believed that rigorous risk analyses were not required based on operating experience and test data. This approach was consistent with the staff's evaluation of the 3-volt ARC amendments approved for Byron Unit 1 and Braidwood Unit 1 on November 9, 1995, and for Braidwood Unit 1 on May 14, 1997. The 3-volt ARCs allowed by the Byron and Braidwood amendments were only applicable during previous operating cycles and are not currently in effect. The staff's logic for not requiring risk assessments for 3-volt ARC requests was an extension of the rationale used to support the deterministic approvals of the 1- and 2-volt ARCs granted in accordance with GL 95-05. That rationale was based on operating experience and test results indicating that actual leakage

from axial cracks confined by drilled-hole tube support plates was likely to remain below the roughly 1 gpm leak rate typically assumed in the licensing basis accident analyses.

In response to the operational leakage experienced during Cycle 8, the STP-2 licensee decided not to fully implement the 3-volt ARC that was approved for Cycle 9. All indications above 1.5 volts were plugged, and all indications between 0.6 and 1.5 volts were reinspected with a rotating pancake coil probe to better characterize the depths of the flaws. On the basis of this additional information, 524 tubes with flaws that appeared to be relatively deep were also plugged. Thus, STP-2 actually implemented an ARC that was much more restrictive than the 3-volt ARC that was approved by the staff, although the ARC was still beyond the 1-volt criteria for 0.75-inch-diameter tubes as discussed in GL 95-05. The licensee plans to replace the STP-2 SGs after Cycle 9.

The Advisory Committee for Reactor Safeguards (ACRS) Ad Hoc Subcommittee report, NUREG-1740, "Voltage-Based Alternate Repair Criteria," dated February 1, 2001, provided conclusions and recommendations relative to the pertinent technical issues associated with Dr. Hopenfeld's DPO. As discussed in the report, the Subcommittee did not attempt to reach conclusions concerning occasions when the staff approved amendments for ARCs that went beyond the voltage criteria in GL 95-05. However, the Subcommittee noted that the amendments should have been accompanied by more complete risk analyses. The ACRS report also questioned the staff's ability to assess (from a risk-perspective) the effect of significant SG tube leakage under severe accident conditions.

As discussed in the revision to the SG Action Plan dated May 11, 2001 (ADAMS Accession No. ML011300073), the staff has developed specific milestones that address the conclusions and recommendations contained in the ACRS Ad Hoc Subcommittee report. In accordance with the action plan, the staff is performing research to improve the capability of performing risk assessments associated with the review of license amendments for SG tube ARC that go beyond the criteria in GL 95-05, and to better understand SG tube leakage under severe accident conditions. Until this work is completed, the staff will evaluate any future proposed license amendment request with due consideration of the issues raised in the ACRS report to ensure that unacceptable risks are not introduced. Consistent with guidance in Regulatory Issue Summary 2001-02, "Guidance on Risk-Informed Decisionmaking in License Amendment Reviews," if the staff concludes that a proposed amendment could introduce new vulnerabilities in risk, the staff will request that the licensee provide the data and analyses necessary to show that risk would remain at acceptable levels. Until many of the milestones identified in the action plan are completed, these types of reviews may pose significant challenges.

With respect to STP-2, the licensee's Special Report stated that the preliminary Operational Assessment confirms that operation may proceed for at least 90 days of Cycle 9 without exceeding the NEI 97-06, Revision 1 performance criteria. A final Operational Assessment will be completed within the 90-day timeframe. The use of the voltage-based ARC methodology described in GL 95-05 is self-limiting in that, if the licensee's projected end-of-cycle voltage distribution results in calculated accident-induced leakage greater than the licensing basis leakage limit, then the NRC must be notified in the final Operation Assessment. Further regulatory action would be taken as required.

The staff believes that the licensee's extensive preventative tube plugging effort during the 8th refueling outage, in conjunction with the operational assessment, provides adequate assurance that the tubes will meet the performance criteria during Cycle 9 operation. However, if operational leakage occurs during Cycle 9 such that the plant design basis could be challenged or a potentially unacceptable increase in risk is created, the staff will determine what additional regulatory actions are appropriate. Technical specification limits on operational leakage still apply. During a meeting on April 19, 2001, the staff requested that the licensee provide information from the last operating cycle (Cycle 8) to assist in the evaluation of the level of operational leakage that the staff would consider significant.

Dr. Hopenfeld asserted in his letter that our memorandum to him dated March 5, 2001, "misrepresented the ACRS findings by stating that the ACRS 'found that no immediate regulatory actions are necessary.'" The ACRS Ad Hoc Subcommittee Chairman, Dr. Powers, was asked to address this assertion at the ACRS meeting with the Commission on May 11, 2001. Dr. Powers replied that, in his opinion, the staff has responded appropriately and consistently with the expectations of the ACRS by formulating research on the issues. He also said that the ACRS had not identified anything that was particularly urgent for the staff to undertake. But, he noted that the ACRS report had not touched on the particular issues related to STP-2. As previously discussed, the staff does not see a need to take action with respect to STP-2 unless there is a recurrence of significant operational leakage during the current operating cycle.

Your memorandum also requested that the staff keep you informed of any significant developments or delays associated with the staff's actions to address the ACRS Ad Hoc Subcommittee report. The staff has completed its review of the ACRS report and has revised the SG Action Plan, as discussed above, to incorporate specific milestones that address the concerns of the ACRS Ad Hoc Subcommittee. The staff will keep you informed of the status of the action plan by the monthly update of the Commission Tracking Memorandum.

cc: Commissioner Dicus
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Commissioner McGaffigan
Commissioner Merrifield
G. Apostolakis, ACRS
SECY
OGC
OCA
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CFO

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cc: Commissioner Dicus OGC
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 Commissioner McGaffigan OPA
 Commissioner Merrifield CFO
 SECY G. Apostolakis, ACRS

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